Fisheries and Oceans Canada | Pêches et Océans Canada
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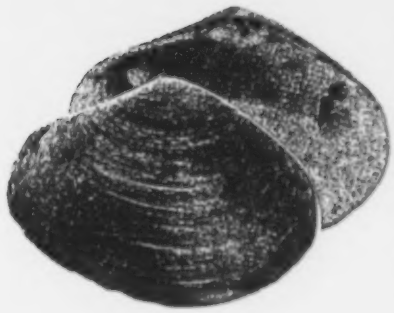
Quebec Region
Canadian Science Advisory Secretariat
Science Advisory Report 2012/009

ASSESSMENT OF THE STIMPSON'S SURFCLAM STOCKS OF QUEBEC COASTAL WATERS IN 2011



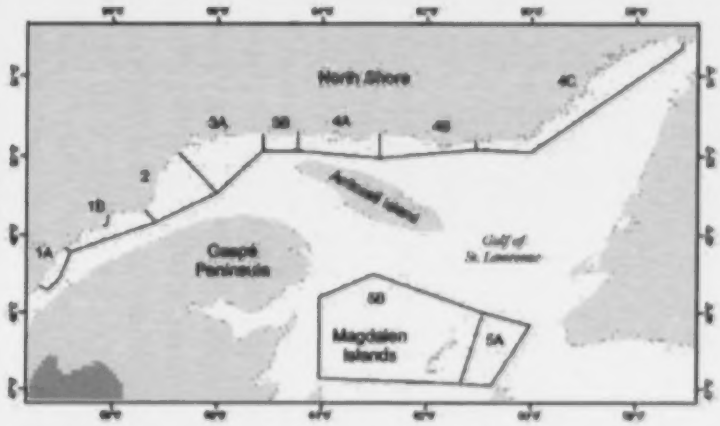


Figure 1. Stimpson's surfclam fishing areas in Quebec.

Context

Stimpson's surfclam (Mactromeris polynyma) fishing is a recent activity in the Gulf of St. Lawrence. The most significant beds are mainly located on the North Shore of Quebec as well as in the Magdalen Islands area. Stimpson's surfclam fishing is conducted inshore using hydraulic dredges, on sandy substrates located 10 to 30 m deep.

Quebec waters are divided into ten fishing areas to which access is limited to a restricted number of fishermen. The effort is also controlled by a fishing season and catches are limited by quota. Until now, the adjustment of the quotas was done with caution due to the slow growth and the sedentariness of this mollusc.

Resource assessment is made every three years in order to determine if the changes that have occurred in the status of the resource justify adjustments to the conservation approach and management plan. The main indicators used in this assessment are derived from landing, logbook and commercial catch sampling data, as well as from research projects in collaboration with the industry.

This Science Advisory Report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, regional advisory meeting of February 9, 2012, on the Assessment of the Stimpson's surfclam fishery in the Quebec inshore waters.

Canada

SUMMARY

- Quebec Stimpson's surfclam landings totalled 842 t in 2011; 95% was from the North Shore and 5% from the Magdalen Islands.
- In 2011, catches per unit effort (CPUE) and mean sizes of surfclams landed were equal or above the time series medians. Throughout the area, fishermen are able to maintain good yields by moving over a same bed or from one bed to another.
- The estimated annual exploitation rates for 2009-2011 in each area, based on the swept area dredged, were on average below 3%, except for areas 4A (3.3%) and 4B (4.3%).
- The hydraulic dredge is extremely efficient and highly selective. There are few by-catches and dredges retain very few undersized surfclams.
- Guidelines have been established to recommend quota adjustments in each fishing area. A quota cannot be increased unless the quota has been reached consistently over the last three years and that CPUE and mean size indicators are equal or above the time series median. In addition, an increase is only possible if the exploitation rate in the area is below 3%. Based on the guidelines, only Area 1A meets all the conditions for recommending a quota increase of 6%. The status quo is recommended for all other areas.
- As a precautionary measure, portions of the bed with a high density of juveniles should be protected from harvesting due to the weak growth and sedentariness of this species.

INTRODUCTION

Species Biology

Stimpson's surfclam (Arctic surfclam), *Mactromeris polynyma*, is an endobenthic sedentary bivalve mollusc that lives buried in sediments. Surfclams gather in "beds" in sandy sediments on the sub tidal or under the low tide line. They rarely move voluntarily. When surfclams are dislodged from sediments, either by currents, waves or fishing gear, they are able to rebury themselves. They are a powerful and active burrowing species, and their burying depth varies and depends on the length of their siphon. They use their in-current siphon to feed, filtering small organisms suspended in water.

On the North Shore, surfclams have been observed at depths ranging between 1 and 48 m. The distribution of beds in this region is closely related to the mouths of large rivers. In the Magdalen Islands, they can be found at depths ranging from 25 to 60 m. They also occur in low densities in certain areas in the Lower St. Lawrence and on the north shore of the Gaspé Peninsula (Figure 2). On a larger scale, Stimpson's surfclams can be found along the west coast of the Atlantic, from Baffin Island to Rhode Island. They are also found on the Pacific coast, from Alaska to Vancouver Island as well as on the east coast of Russia.

Stimpson's surfclams have a slow growth and a significant lifespan. On the North Shore, they require between 13 and 15 years to reach their legal size of 80 mm (anteroposterior length) and more than 20 years in the Magdalen Islands. Ten surfclams, among several that were tagged on the shell in 1995, were recaptured on the Longue-Pointe-de-Mingan bed (Area 4A) 8-16 years

after being tagged. Growth was estimated at less than 1 mm per year after reaching 100 mm. The mean size of surfclams harvested on the North Shore and in the Magdalen Islands is around 110 and 100 mm respectively, which would represent individuals of at least 25 years of age. The oldest specimens with sizes that reach 150 mm on the North Shore and 130 mm in the Magdalen Islands could be more than 75 years of age.

Sexes are separate and size at sexual maturity would be around 60 mm, which represents around 9 years of age. Surfclams are therefore able to reproduce a few years before being recruited to the fishery. However, size at sexual maturity may vary according to the sex and fishing area. Reproduction is synchronous and fertilization occurs in the water column. In the Middle North Shore, spawning would occur primarily from late June to late July. In certain sectors, there could also be a second spawning period later in the fall. After eggs hatch, a pelagic larval stage extending over a few weeks precedes benthic life.

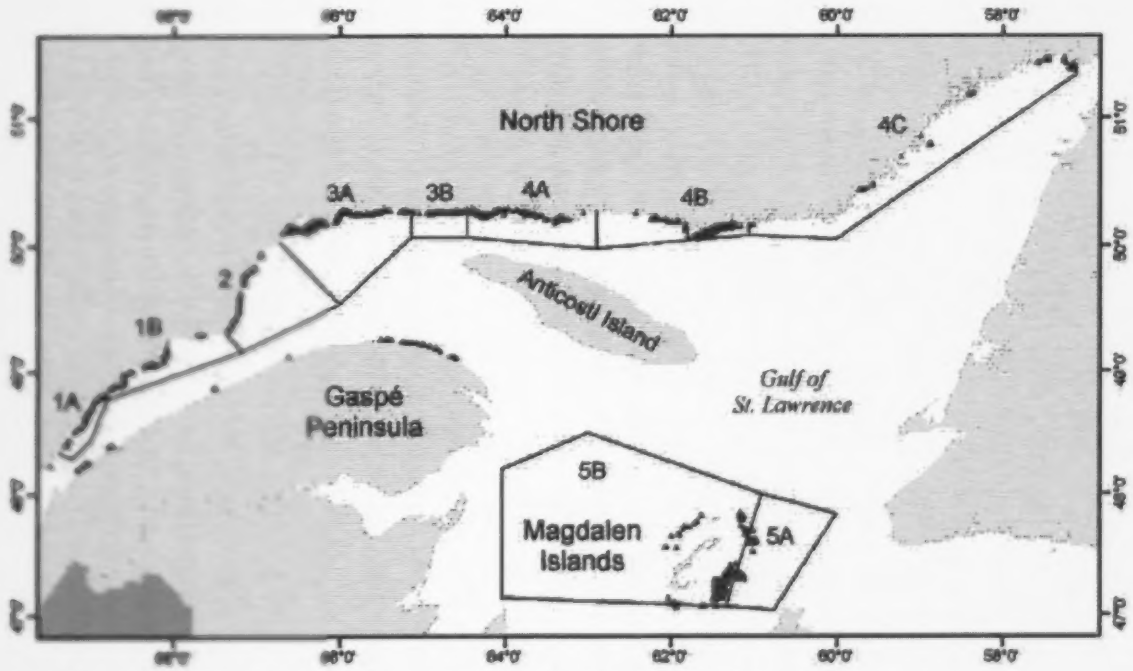


Figure 2. Known distribution for Stimpson's surfclam in Quebec coastal waters.

Description of the Fishery

The first exploratory fisheries in the northern Gulf of St. Lawrence were conducted in 1990 in response to interest expressed by fishermen and industry. Beginning in 1993, the fishery developed on the North Shore and in the Magdalen Islands and annual landings from these two sectors fluctuated between 200 and 500 t until 2002 (Figure 3). In 2003, fishermen began harvesting in Area 4B and annual landings have since increased to approximately 850-900 t, except in 2007 and 2008.

The Stimpson's surfclam fishery requires the use of a hydraulic dredge. This dredge is designed to be extremely efficient, with a low by-catch rate and retain few undersized surfclams. The dredge typically used in Quebec is the New England model whose basket is approximately 1.83 m (2.13 m in the Magdalen Islands) wide by 1.83 m long. Spacing between basket stems must

be at least 3.175 cm. The effectiveness of this type of dredge was estimated at more than 90% for surfclams measuring more than 80 mm.

In Quebec, the Stimpson's surfclam fishery is complementary, which means that fishermen practice other fisheries during the year. The region has ten fishing areas, eight on the North Shore and two in the Magdalen Islands (Figure 1). This inshore fishery is managed throughout the area by the number of licenses, a fishing season, quotas and a minimum catch size of 80 mm (Table 1). In 2011, fifteen permanent licenses and three exploratory licenses were issued. Some licenses can give access to more than one fishing area. In 2011, areas 4C and 5A were not exploited.

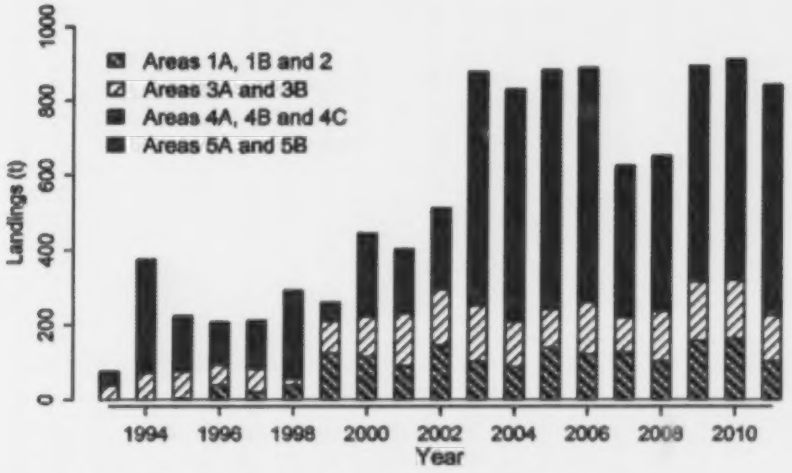


Figure 3. Annual Stimpson's surfclam landings in Quebec per fishing area.

Table 1. Management measures for Stimpson's surfclams in 2011.

Management measures	Fishing area									
	1A	1B	2	3A	3B	4A	4B	4C	5A	5B
Number of licences (exploratory)	1	1	4	2	2	2	5	(3)	4	4
Quota (t)	75.5	68.6	54.9	80.4	88.4	174.5	425.0	171.1	204.0	113.0
Quota management[1]	Comp.	Comp.	Comp.	ITQ	ITQ	ITQ	Comp.	Comp.	Comp.	Comp.
Start of fishing season	30/06	13/07	01/07	01/07	01/07	01/07	13/06	22/07	[2]	[2]
End of fishing season	31/10	12/10	13/11	10/11	10/11	10/11	01/11	18/10	[2]	[2]
Hail in	←			100%		→		0%	←	100% →
Number of dredges	←				1					→
Dredge width	←			1.83 m		→			←	2.13 m →
Stem spacing	←				3.175 cm					→
Minimal size	←				80 mm					→

[1] = *Comp. (competitive fishing), ITQ (individual transferable quota with restriction)*

ASSESSMENT

The assessment of the Stimpson's surfclam stock status is mostly based on analysis of commercial fishery data. These data come from three different sources of information; purchase slip, fisherman's daily logbook and samples of commercial catches collected dockside by Fisheries and Oceans Canada (DFO). Scientific surveys and exploratory fisheries enhance information regarding species' distribution and population dynamics.

Stimpson's surfclam landings are expressed in tons, live weight, or the whole surfclam. Mean landings over the last three years totalled 884 t, up 22% compared with the 2006-2008 period (Figure 3). This increase is due to an increase in fishing effort. In 2011, landings totalled 842 t: 95% were from the North Shore and 5% were from the Magdalen Islands. The total allowable catch (TAC) was reached over the last three seasons in areas 1A, 3A, 3B, 4A and 4B. Landings were recorded in areas 1B, 2 and 5B, but the TAC was not reached. Areas 4C and 5A were harvested little if at all.

CPUE are very high in most areas. CPUE from 2009 to 2011 were either higher than or equal to the time series median (Table 2). Fishermen are able to maintain good yields by moving over a same bed or by distributing their effort over different beds in a same area. This behaviour would explain the hyperstability observed so far in the CPUE. Particularly since, in most areas, the locations where surfclams occur are relatively large compared to the areas dredged, the effects of the fishery on the mean CPUE cannot be determined yet. On a small scale however, it is assumed that the effect of the fishery is likely to translate into a decrease in density, CPUE and mean size.

Mean sizes of landed surfclams are high in all areas. They remain higher than or equal to the time series median (Table 3). Again, this hyperstability can be explained by the fact that fishermen move around. A response to exploitation, by reducing the mean size, cannot yet be measured for the entire area. The number of individuals measuring less than 80 mm in the landings is negligible due to the dredge's selectivity.

Table 2. Catches per unit of effort (kg per tow for a 1 m wide tow) estimated using logbook data.

Year	Fishing area									
	1A	1B	2	3A	3B	4A	4B	4C	5A	5B
2006	147	32	85	87	150	156	97			56
2007	134	50	98	101	112	179	83			56
2008	121		136	106	150	179	98	59		58
2009	158	132	128	103	183	172	125			
2010	146	145	104	89	173	150	107			39
2011	148	114		76	169	151	119			56
$Median_{1993-2010}$	127.6	78.5	100.3	75.5	138.7	153.7	115.6	58.8	51.0	55.7

Table 3. Mean size (mm) of Stimpson's surfclams at landing.

Year	Fishing area									
	1A	1B	2	3A	3B	4A	4B	4C	5A	5B
2006	109.3		116.4	106.2	104.7	106.2	104.1			
2007	109.5		115.3	107.5	110.2	113.0	101.5			101.6
2008	108.6		114.2	108.4	107.7	113.5	102.3			
2009	106.1	116.8	116.3	115.9	117.5	113.7	100.0			
2010	115.3	113.4	116.5	111.7	115.2	116.3	107.2			
2011	113.7	117.3		107.3	115.1	116.6	104.6			
$Median_{1993-2010}$	109.3	104.8	114.4	109.8	111.0	112.0	102.8			99.0

An exploitation index was developed for the primary beds harvested. First, the surface portion of the bed that is exploited was calculated using daily fishing positions recorded in the logbooks between 1993 and 2011. This surface area circumscribes 95% of fishing effort during the reference period. Second, the area annually dredged per bed was calculated by multiplying the number of tows, by the average duration of a tow, the width of the dredge and vessel speed. The exploitation index for a given year was calculated by area as the ratio between the portion dredged and the harvested portion for all beds in the area. The estimated exploitation rate does not account for possible dredge tow overlapping and that a bed's harvested area could be larger than what is currently measured.

The estimated annual exploitation rates for 2009-2011 in each area were on average below 3%, except for areas 4A (3.3%) and 4B (4.3%) (Table 4). Although exploitation rates are low across most areas, they may be higher in certain beds: Cap Colombier, Area 1B (9.6%); Cap Colombier, Area 1A (5.7%); Sept-Îles, Area 3A (5.2%); Natashquan, Area 4B (4.3%) and Longue Pointe de Mingan, Area 4A (4.0%). Such exploitation rates may not be sustainable in the long term.

Table 4. Stimpson's surfclam bed surface area, dredged area and mean exploitation rates from 2009 to 2011.

Fishing area	Bed surface area (km^2)	Bed exploited surface area (km^2)	Dredged surface area (km^2)		Exploitation rate 2009-2011 (%)
			Total 1993-2011	Annual average 2009-2011	
1A	17.015	4.512	0.807	0.057	1.27
1B	13.639	2.712	0.633	0.040	1.49
2	28.382	2.748	0.452	0.021	0.77
3A	28.415	2.751	1.218	0.078	2.82
3B	16.481	3.628	0.908	0.055	1.52
4A	17.966	3.724	1.936	0.122	3.28
4B	67.889	9.549	3.668	0.407	4.27
4C	3.217	0.000	0.002	0.000	0.00
5A	20.302	0.000	0.055	0.000	0.00
5B	436.457	2.135	1.302	0.034	1.61

Negative exploitation signals were observed throughout the bed in Area 3A and in the Rocher aux Oiseaux bed (Area 5B). Most of the fishing effort in Area 3A occurs on the Cayes de l'Est and Rivière Moisie beds. Over the past three years, a decrease in CPUE and median and maximum sizes has been observed. When harvesting began in the Magdalen Islands, effort was concentrated on the Rocher aux Oiseaux bed. A drop in CPUE has been observed from the beginning of harvesting operations. Now the effort is very low and fishermen are exploiting other fishing sites.

Research surveys were conducted on the North Shore in 2009 and 2010. Three beds were sampled: Forestville (Area 1A), Longue Pointe de Mingan (Area 4A) and Natashquan (Area 4B). It was observed that areas with a high density of juveniles (size <80 mm) were located within the beds. However, commercial size surfclams (>80 mm) were more evenly distributed within the beds. High density areas were observed with commercial size maximums of 12, 22 and 12 surfclams/m^2 for the Forestville, Longue Pointe de Mingan and Natashquan beds.

Commercial biomasses estimated from surveys on the Forestville, Longue Pointe de Mingan and Natashquan beds totalled 3 015, 3 649 and 25 888 t respectively. It is known that surfclams are distributed beyond the limits of the sampled depths, either in shallower or deeper waters. Total biomasses would therefore be higher than those estimated. According to the 2011 TAC, estimated exploitation rates from these biomasses were 2.5% for Forestville, 4.8% for Longue Pointe de Mingan and 1.6% for Natashquan. According to the surplus production model results, the productivity of these beds is very low and exploitation rates are higher than or equal to the replacement yield.

Ecosystem Considerations

Dredges used for harvesting Stimpson's surfclams have an immediate impact on substrate and benthic organisms, as they liquefy the sediment up to 20 cm deep to collect most of of the larger organisms and cause sedimentation adjacent to the dredge's path. The recovery speed of benthic communities that are affected would vary depending on the site's depth, sediment type and degree of hydrodynamics. Shallower sites with higher hydrodynamics produced by waves or currents seem to recover their initial state of sediment compaction and faunal composition between a few days to a few months after the dredge has passed. This rapid recovery is potentially caused by the fact that the high hydrodynamics and natural instability of sandy bottoms helps communities more resilient to disturbance. However, there are some uncertainties about the effect of dredging on benthic productivity in general.

Fishing effort is not distributed uniformly in the surfclam's known habitat. Fishermen prefer to frequent portions of a bed with high concentrations of surfclams. The annual average surface area dredged from 2009-2011 totalled 0.781 km^2 on the North Shore and 0.034 km^2 in the Magdalen Islands. The footprint of this fishery on the habitat is relatively small compared to the surface areas of known beds: 193 km^2 on the North Shore and 457 km^2 in the Magdalen Islands, or less than 0.5% of the known surfclam habitat.

In commercial fishing situations, the dredge is very selective. Stimpson's surfclams account for 91.7% of the catch in numbers (Table 5). The other most common species are the sand dollar, Northern propellerclam, whelks, Greenland cockle, truncate softshell, green sea urchin, Arctic wedgeclam, Iceland cockle, brittle stars, Atlantic razor, Ocean quahog and hermit crabs. Along with the Stimpson's surfclam, these species account for over 99.8% of individuals caught in fishing situations. For individuals not selected by the dredge, the percentage of damaged individuals was low.

Table 5. Relative frequency (%) of taxa captured contributing to 99.8% of catches (in numbers) in the commercial fishery in the Upper and Middle North Shore from 1923 to 2010 (455 sampled tows).

Name	Scientific name	Group	%	Cumulative %
Stimpson's surfclam	*Mactromeris polynyma*	Bivalvia	91.73	91.73
Sand dollar	*Echinarachnius parma*	Echinodermata	4.12	95.86
Northern propellerclam	*Cyrtodaria siliqua*	Bivalvia	1.94	97.79
Whelks	*Buccinum* spp.	Gastropoda	0.63	98.43
Greenland cockle	*Serripes groenlandicus*	Bivalvia	0.50	98.92
Truncate softshell	*Mya truncata*	Bivalvia	0.31	99.23
Green sea urchin	*Strongylocentrotus droebachiensis*	Echinodermata	0.18	99.41
Arctic wedgeclam	*Mesodesma arctatum*	Bivalvia	0.11	99.53
Iceland cockle	*Ciliatocardium ciliatum ciliatum*	Bivalvia	0.07	99.59
Brittle stars	*Ophiura* sp.	Echinodermata	0.06	99.66
Atlantic razor	*Siliqua costata*	Bivalvia	0.06	99.72
Ocean quahog	*Arctica islandica*	Bivalvia	0.05	99.76
Hermit crabs	*Pagurus* sp.	Crustacea	0.03	99.80

Sources of Uncertainty

This assessment is based primarily on indices derived using logbook data and commercial capture sampling at dockside. Independent sources of information are available only for a limited number of beds. With unknown exploitation rates based on exploitable biomass, bed productivity and recruitment, using an empirical approach seems to be the only mean to adjust quotas.

CONCLUSIONS AND ADVICE

Over the last three years, catches per unit effort (CPUE) and mean sizes of surfclams landed were equal or above the time series medians. Throughout the area, harvesters are able to maintain good yields by moving over a same bed or from one bed to another. The estimated annual exploitation rates for 2009-2011 in each area, based on the swept area dredged, were on average below 3% except for areas 4A (3.3%) and 4B (4.3%). Nevertheless, the exploitation rate may be higher in individual beds.

Quota increases must be conservative as the weak growth rate and the sedentariness of this species make certain sites vulnerable to overexploitation. Guidelines have been established to recommend quota adjustments in each fishing area. Increases should not exceed 6% per 3-year period. A quota cannot be increased unless it has been reached consistently over the last three years and the CPUE and mean size indicators are equal or above the time series median. In addition, an increase is only possible if the exploitation rate in the area is below 3%. Based on these guidelines, a 6% increase can only be considered for Area 1A. The status quo is recommended for all other areas.

OTHER CONSIDERATIONS

Conservation Approach

The objective of the conservation approach for the Stimpson's surfclam is to protect the reproductive potential and genetic integrity of populations, as well as limit the fishery's impact on the ecosystem.

To achieve this, Quebec is divided into several fishing areas where access is limited to only a few fishermen (1-5 fishermen per area). Generally, they have access to the area from July to October and harvesting is restricted by a TAC. In most fishing areas, there are also areas closed on account of unsafe shellfish. These closed areas protect a certain portion of the population from harvesting. Furthermore, the density of spawners is critical for reproductive success and protecting small areas with high density may be beneficial for the population. Similarly, portions of beds with a high density of juveniles should be protected from the fishery. The exploitation rate must remain low given their low productivity.

Most surfclams are mature at 60 mm, but the contribution of smaller surfclams to the population's reproductive effort is relatively low. In order to give surfclams the opportunity to reproduce a few years before being harvested, the minimum catch size was set at 80 mm. The spacing of the dredge's stems is set at 3.175 cm, or the same thickness as an 80 mm clam, which minimizes the harvesting of surfclams smaller than 80 mm.

The impact of the fishery on habitat is limited, as are by-catches, due to the hydraulic dredge, which is very efficient in minimizing the fishing effort required to reach the TAC. In addition, this highly selective dredge collects only commercial size surfclams and by-catches are very low.

SOURCES OF INFORMATION

This Science Advisory Report is from Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Regional Advisory Meeting of February 9, 2012, on the Assessment of the Stimpson's surfclam fishery in the Quebec inshore waters. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at: http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

Bourassa, L., Giguère, M., Brulotte, S., Cyr, C., and Perreault, L. 2008. Évaluation de la croissance, du taux d'exploitation et du recrutement à la pêche de la mactre de Stimpson (*Mactromeris polynyma*) de la Moyenne-Côte-Nord, Québec. Can. Tech. Rep. Fish. Aquat. Sci. 2799: x + 39 p.

Bourdages, H. and Goudreau, P. 2012. Évaluation de la pêche à la mactre de Stimpson des eaux côtières du Québec en 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/008.

Lambert, J., and Goudreau, P. 1995. Performance de la drague hydraulique de type Nouvelle-Angleterre pour la récolte de la mactre de Stimpson (*Mactromeris polynyma*). Can. Ind. Rep. Fish. Aquat. Sci. 235: vii + 28 p.

Lambert, J. and Goudreau, P. 1997. Biologie et exploitation de la mactre de Stimpson (*Mactromeris polynyma*) sur les côtes du Québec. DFO Sec. can. éval. stock, Doc. Rech. 97/101. 44 p.

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